THE DEVELOPMENT OF TEACHING MODEL USING PROBLEM-BASED LEARNING WITH COOPERATIVE LEARNING IN A SUBJECT OF DATA STRUCTURES AND ALGORITHMS

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ABSTRACT

The Problem-based Learning (PBL) is a student-centered approach in which students learn about a subject by working in groups to solve open-ended problems themselves under the guidance or coaching of a teacher. Together with the Cooperative Learning (CL), this style of learning approach is a small group learning which aims at working and accomplishing goals together conducted under a common goal structure. It is effective when all group members share the responsibility for problem solving. This research article presents about a teaching model using Problem-based Learning (PBL) with Cooperative Learning (CL) in the subject of Data Structures and Algorithms. Each learning topic in each chapter Includes answering questions at the end of the lesson. The researcher or teacher assigned problems to each group of students using the Problem-based Learning with the advice of the teacher on solving the problem. After that, each group would present an algorithm to solve each problem.

The results of using PBL and CL approaches to the learning of Data Structures and Algorithms showed that in academic year 2/2021, assessment result of students' exercises was equal to 80.58 percent. The result of the achievement test was equal to 81.92 percent. Also, in academic year 2022 (2/2022), the assessment result of students' exercises was equal to 90.18. The result of the achievement test was equal to 92.52

percent, indicating that the scores of academic year 2022 year were higher than those for the academic year 2021. In conclusion, the results from applying the problem-based teaching model together with cooperative learning will enable students to analyze and design algorithms better because they can see the problems that occur together. Participation has resulted in the exchange of methods for analyzing and designing more diverse algorithms and can answer the learning objectives in this course.

Keywords: Problem-Base Learning, Cooperative Learning, Learning Achievement

INTRODUCTION

Bachelor of Science Program, Digital and Information Technology Management is a curriculum revised in 2022 with a total number of credits throughout the curriculum not less than 130 credits which includes: General Education Courses: 30 credits; Specifications/ Concentration Courses: 94 credits; and Elective Courses: 9 credits. Also, for the subject of Data Structures and Algorithms (5652201), the teaching documents were developed to be used in teaching and learning in this subject, and the content and knowledge were collected in accordance with the curriculum structure according to the National Education Act (No. 4) B.E. 2562 (2020) and Undergraduate Program Standard Criteria B.E. 2558 (2015). (Intarapadung, 2022) The teaching documents mentioned above were used in the teaching model using Problem-based Learning and Cooperative Learning with the students of Information Technology Management who studied in the academic year 2/2022.

Concepts and learning theories of Problem-Based Learning (PBL),describe a learning model that allows learners to create their own knowledge by using real-world problems as a learning context for them to develop critical thinking and problem-solving skills. This is the result of a process that requires understanding and problem-solving. The advantages of PBL were included: the learners are able to develop skills for making hypotheses and reasoning, develop self-learning skills, work in groups, and improve communication. In addition, the factors affecting the quality of Problem-based Learning (PBL) depended on these 7 important factors: (1) the importance of the content; (2) the quality of problem-solving problems; (3) the group learning process, which both teachers and learners must understand the dynamics of the group process; (4) roles and skills of the teachers; (5) developing skills of both teachers and students; (6) learning

resources; and (7) management, cooperation, and coordination between departments or faculties appropriately for more effective teaching and learning. (Suwannoi, 2023)

Cooperative Learning (CL) is a teaching approach that uses a collaborative way to solve problems by working in a group or team so that students can practice working together for the common good. There are many ways of learning using the Cooperative Learning (CL), such as report writing, creative activities, or discussions in front of the class. The teachers must decide which cooperative learning method is suitable for the group of students. Most importantly, Cooperative Learning (CL) is successful when all learners in a group are accountable for their responsibilities to achieve their common objectives. Cooperative Learning has four characteristics, including: (1) Interaction within the group for positive collaboration; (2) Group members should not be more than 6 people; (3) Group members should have various abilities to achieve in-group synergies; (4) Group members should have clear responsibilities to focus on fulfilling their duties. When all group members are well accountable, it can make the group more efficient. (Na Nongkhai & Kaewkiriya, 2016)

Objectives

(1) To apply a problem-based teaching model with collaborative learning in the subject: Data Structures and Algorithms. Bachelor of Science Program Information Technology Management major

(2) To study academic achievement in the subject: Data Structures and Algorithms before and after studying.

Literature Review

To create problem-based learning in the Data Structures and Algorithms course in the Bachelor of Science program. Information Technology Management major. The researcher has tried to find knowledge that will be a starting point for teaching and learning by trying to integrate three groups of theories together, as shown in Figure 1.
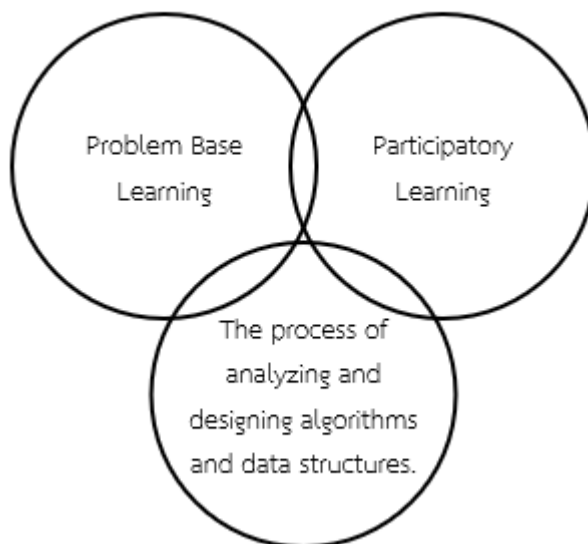
Figure 1. Model for applying problem-based learning to the subject
of Data Structures and Algorithms.

Figure 1: Theory of problem-based learning (PBL) and participatory learning (PL), which is a learning management theory that is very different from the learner-centered theory group. It is learning by using problems. It will be characterized as a basic perception of the learner's experience. It emphasizes making learners responsible for their own learning. It is an integration of knowledge domains or cross-disciplinary learning. It is a combination of theory and practice. It focuses on the process of acquiring or increasing knowledge rather than the outcome or output. It is a change in role from instructor to facilitator. It is a change from an assessor (staff assessment) determining the results of learning to a learner evaluating themselves or assessment in the form of self-peer assessment, focusing on building expertise in communication and interpersonal relationships. Assist learners in understanding and acquiring all the knowledge that the curriculum or course structure has specified. (Cheewakriangkrai & Sriaroon, 2016)

Faculty of Industrial Technology Phranakhon Rajabhat University offers the course 5652201 Data Structure and Algorithm (Data Structure and Algorithm) to students studying information technology management and communication technology. The course description is set out as follows: Inductive mathematics reverse programming Algorithm design and analysis of data types Abstract data structures and data types calculation of the time it takes for the algorithm to work. Basic data structure These include lists, stacks,

and queues. Dynamic data structures include linked lists. Vocabulary related for trees, binary trees, binary search trees, AVL trees, sorting, and data searching. The researcher has divided the learning content into 10 chapters, as follows: Chapter 1. Introduction Chapter 2. Algorithm Performance Chapter 3. Arrays Chapter 4. Stack Structure Chapter 5. Queue Structure Chapter 6. Linked List Structures Chapter 7. Tree Structures Chapter 8. Graph Structures Chapter 9. Hash Table Structures Chapter 10. Sorting and Search Algorithms

Methods

This research was experimental research. The data were collected from the students of Information Technology Management, Faculty of Industrial Technology, Phranakhon Rajabhat University, who studied in the 2/2022 academic year. It started with the method of problem setting and dividing the students into 2 groups, with 6 members in each group, with a pre-test and a post-test (One Group Pretest Posttest Design). Then the students would be asked to complete exercises at the end of each lesson in order to find the learning achievements in the teaching model by using Problem-based Learning (PBL) with Cooperative Learning (CL), along with using teaching documents as teaching materials. Also, the statistical results calculated by computer programs were used to compare the learning achievement of students in the 2/2021 academic year. The research process can be summarized as follows:

1) Studying the learning theories of Problem-based Learning (PBL) and cooperative learning (CL).

2) Designing a conceptual framework for Problem-based Learning with Cooperative Learning, which came out in 2 main steps:

2.1) Using the Cooperative Learning method, students were divided into 2 groups of 6 people randomly. Then students studied the algorithms to solve problems, in which the problems were defined in each chapter or content for each week to be used in activities by dividing the responsibilities of each person within the group.

2.2) After the task was assigned, the students jointly solved the problems by brainstorming to design an algorithm and write a program to try and solve the problems. The teacher's role was mainly to observe each group of learners working together. If any problem could be solved within the period, each group would be asked to present their own algorithms designed to solve the problem. But if the class was dismissed,

the student would take the problems to work outside the class, which would be both of Cooperative Learning and Problem-based Learning.

3) Before beginning each lesson, the students must take a pre-test. Then, after the end of each lesson, the students were also required to do exercises at the end of the lesson and a post-test.

4) Comparing the learning achievement of the two groups of students (in academic years 2/2021 and 2/2022) to analyze the learning achievement of the subject of Data Structures and Algorithms whether teaching with the combination of Problem-based Learning and Cooperative Learning could lead to better learning efficiency or not.

Summary of the statistical analysis obtained from the comparison of the learning achievement of the 2 groups of students (academic year 2/2021 and 2/2022). The research methodology and stages can be summarized as shown in Figure 2.
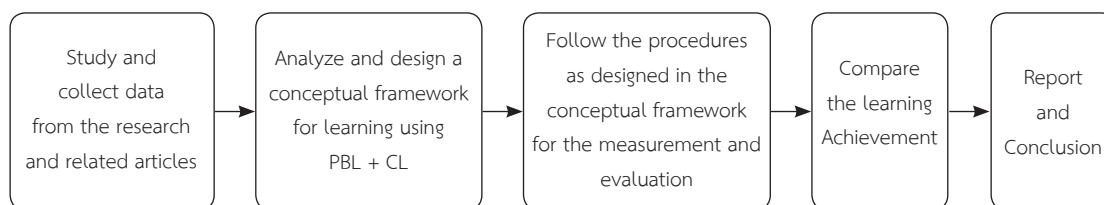
Figure 2 Implementation Stages

From Figure 2, the results of the operation process are summarized: a problem-based teaching model combined with cooperative learning is appropriate for the Data Structures and Algorithms course. and can be used as a model for teaching and learning in other subjects.

Results and Discussions

This research aimed to develop a teaching model using Problem-based Learning and Cooperative Learning in the subject of Data Structures and Algorithms (5652201) Bachelor of Science in Information Technology Management, Faculty of Industrial Technology, Phranakhon Rajabhat University. The research results were as follows:

The Comparison of Student Average Scores between Academic Year 2/2021 and 2/2022, from the comparison between Problem-based Learning and Cooperative

Learning using teaching documents as teaching materials, then gathering the data from the comparison of learning achievements by doing exercises at the end of each lesson and pretests and posttests, the analysis results were shown in tables 1 and 2.

Table 1 Comparison of Learning Achievements of Students in Academic Year 2/2021

Scores	N	$\sum^X$	$\overline{X}$	Percent
Scores of Exercises (at the end of each lesson)	12	967	80.58	80.58
Scores of Pretests and Posttests	12	983	81.92	81.92

From Table 1, it showed that in the application of the Problem-Based Learning with Cooperative Learning in the subject of Data Structures and Algorithms (5652201) which was used for the students in the academic year 2/2021, a total of 12 students answered the exercises during the classes correctly which was equal to 80.58 percent. They were also able to take the exam on their learning achievement after studying correctly, which was equal to 81.92 percent.

Table 2 Comparison of Learning Achievement of Students in Academic Year 2/2022

Scores	N	$\sum^X$	$\overline{X}$	Percent
Scores of Exercises (at the end of each lesson)	12	997	90.18	90.18
Scores of Pretests and Posttests	12	992	92.52	92.52

From Table 2, it showed that the application of the Problem-based Learning model with Cooperative Learning in the Data Structures and Algorithms course (5652201) which was used for the students in the academic year 2/2022, resulted in a total of 12 students who answered the exercises during the classes correctly, which was equal to 90.18 percent. They were also able to take the exam on their learning achievement after studying correctly, which was equal to 92.52 percent. The scores in the academic year 2/2022 were higher than the scores in the academic year 2/2021.

Suggestions: The students are required to apply the results of their algorithm designs to write programming codes for testing the algorithms in solving problems during the brainstorming and problem-solving process in the Data Structures and Algorithms. Therefore, in order for students to be able to apply algorithms to solve real problems, they should first study basic programming in any high-level computer language before taking this course.

Conclusions

The research results in the Development of Teaching Model using Problem-Based Learning with Cooperative Learning in the subject of Data Structures and Algorithms to compare the students' learning achievements in the subject of Data Structures and Algorithms (5652201), Bachelor of Science in Digital and Information Technology Management, Faculty of Industrial Technology, Phranakhon Rajabhat University, In this study, the researcher studies, analyzes, and synthesizes the course descriptions in order to determine the course objectives. Then the problems were set out in the content of each lesson. The scores of the pre-test and post-test, including the exercises at the end of each lesson, were all compared with the mean scores of each lesson between the two groups of students. It was found that the 12 students in the academic year 2/2021 answered the exercises during the classes correctly, which was equal to 80.58 percent. They were also able to take the exam on their learning achievement after studying correctly, which was equal to 81.92 percent.

It was also found that the 12 students in academic year 2/2022 answered exercises during the classes correctly, which was equal to 90.18 percent. They were also able to take the exam on their learning achievement after studying correctly, which was equal to 92.52 percent. The scores in the academic year 2/2022 were higher than the scores in the academic year 2/2021. Therefore, it can be seen that the results of applying the problem-based teaching model together with cooperative learning will enable students to analyze and design algorithms better because they can see the problems. This, along with participation, has led to an exchange of methods for analyzing and designing more diverse algorithms. and can answer the learning objectives in this course.

Acknowledgement

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